Original Article

Test-retest reliability of transcarpal sensory NCV method for diagnosis of carpal tunnel syndrome

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Abstract

Background: Carpal Tunnel Syndrome (CTS) is the most frequent entrapment neuropathy affecting the upper extremity. There are a variety of electrodiagnostic methods available for documenting median neuropathy in CTS. In some studies, determining the sensory NCV across the palm-wrist segment has been introduced as the most sensitive diagnostic procedure for CTS. The aim of this study was to investigate the test-retest reliability of transcarpal median sensory NCV method for the diagnosis of CTS. **Materials and Methods:** Twenty-three patients with clinical symptoms of CTS were tested two times by two different practitioners in one session and again by the first practitioner after one week. Stimulation of the median nerve was performed in the wrist and palm, with a conduction distance maximum of 7 cm, reliabilities of median nerves sensory nerve action potential latencies with stimulation at wrist and palm (W-SNAP, P-SNAP) and its transcarpal NCV were assessed with intraclass correlation coefficient (ICC). **Results:** Comparison of the obtained values, which were done by two practitioners in one session showed ICC of W-SNAP latency, P-SNAP latency and transcarpal NCV of 0.93, 0.88 and 0.87, respectively and values that were done by one practitioner in two sessions with one-week interval showed ICC of 0.60, 0.50 and 0.47, respectively. **Conclusion:** Our findings suggest excellent interpractitioner test-retest reliability of transcarpal median sensory NCV method for diagnosing CTS.

Key Words

Carpal tunnel syndrome, electrodiagnosis, reliability of results

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Introduction

Carpal Tunnel Syndrome (CTS) is the best studied and the most frequent entrapment neuropathy affecting the upper extremity with an estimated prevalence of 2.7%.[1,2] The most typical symptoms are numbness and tingling in the median nerve territory but have been reported to be present in all fingers.[3] Thumb abduction weakness and atrophy of the thenar eminence are also predictors of CTS.

The diagnosis is made based on the history, physical examination, and electrophysiological evaluation.[4] There are a variety of electrodiagnostic methods available for documenting median neuropathy in CTS.[2,5,6] However, the strength of recommendation to use electrodiagnosis is different in each technique based on the quality and consistency of the supporting evidence.

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It is generally accepted that sensory nerve conduction studies are more sensitive than motor nerve conduction study.[6] Transcarpal sensory and motor latency have been used to diagnose CTS in addition to many other methods, and they are recommended to be performed when routine sensory and motor distal latencies are inconclusive to increase diagnostic yield.[7] In some studies, determining the sensory NCV across the palm-wrist segment has been introduced as the most sensitive diagnostic procedure for CTS with a sensitivity ranging from 98.5% to 99%.[8,9]

Increase in the use of this method in clinical trials and research and attention to quality in health care have heightened interest in the reliability of results. The aim of this study was to investigate the test-retest reliability of transcarpal sensory NCV method of the median nerve for diagnosis of CTS between two different practitioners in one session and again by the first practitioner after one week.

Materials and Methods

Participants

A total of 23 patients with clinical diagnosis of CTS, referred to our clinic, were recruited using inclusion and exclusion

criteria. Patients with symptoms and/or signs of CTS and mild or moderate CTS according to neurophysiologic classification entered our study: Symptoms including hand numbness, tingling, paresthesia and nocturnal pain in the median nerve distribution area, which lasted for at least 3 months, signs including Tinel's sign or positive Phalen's test,[10] weakness especially abduction of digit 1 and the sensory deficit in the median territory. Mild CTS is prolonged sensory or mixed-nerve action potential distal latency. Moderate CTS is abnormal median sensory latency as mild CTS, and prolongation of median motor distal latency.

Exclusion criteria consisted of absent median sensory nerve action potential (SNAP), history of any other neurologic disorder, history of median nerve releasing surgery, diabetes or systemic disease that could affect nerve conduction studies. After the researcher's explanation, the patients enrolled in the study and filled and signed the consensus sheet.

Study method

The electrodiagnostic studies were performed using dual-channel Medelec Synergy instrument and setting for recorders of sensory potentials were as follows: Sweep speed: 10 ms, sensitivity: 20 μv/div, pulse duration: 100-200 μs. All tests were conducted at the same surface skin temperature of hand at >32°C. Median sensory nerve action potentials were obtained with wrist (W-SNAP) and palm (P-SNAP) antidromic stimulation (7 cm-14 cm technique). Recording electrode was placed on digit 3, 1-2 cm distal to MCP joint. Distance divided by peak latencies subtractions yielded the transcarpal velocity. For test-retest reliability, the measurements were done by two practitioners, independently in one session and then repeated by one of them after one week.

Data analysis

Analyses were performed using SPSS, version 17.0. The relative retest reliability of tests was determined by the intraclass correlation coefficient (ICC), using a 2-way random-effects ANOVA model and the absolute agreement definition. According to Fleiss' classification: ICC value ≥0.75 indicates "excellent" reliability; ICC value between 0.41 and 0.74 indicates "fair to good" reliability; and ICC value <0.40 indicates "poor" reliability.[11] *P* values less than 0.05 were considered significant.

Results

Demographic data

All 23 patients completed the study. Mild and moderate CTS according to neurophysiologic classification were diagnosed in them. The mean age was 27 years (range 22-38 years), of whom 13 were women, and the dominant hand was affected in 12 patients.

Interpractitioner difference

Comparison of the obtained values that were done by two practitioners in one session showed ICC of W-SNAP latency, P-SNAP latency and transcarpal NCV of 0.93, 0.88 and 0.87, respectively [Table 1].

Intrapractitioner difference

Comparison of the obtained values that were done by one practitioner in two sessions with one-week interval showed ICC of W-SNAP latency, P-SNAP latency and transcarpal NCV of 0.60, 0.50 and 0.47, respectively [Table 2].

Discussion

Diagnosing median nerve compression at the wrist is easy by history and clinical examination. However, before deciding on treatment, electrodiagnostic tests should be performed to exclude other causes of acroparesthesia.

Nowadays, increasing understanding about CTS makes it possible to have these patients in their earlier stages of the disease in electrodiagnostic clinics; however, up to 40% of the patients with typical symptoms may have no electrodiagnostic evidence of CTS.[12]

Determining a method's repeatability is an important point in its validation. It is a basic requirement to detect differences between patients and over a period of time. Recording sensory antidromic NCV occasionally reveals technical problems in determining peak latencies of the proximal and distal responses as well as technical errors in determining the distance between stimulation sites, making good repeatability uncertain.

Serial studies aiming to assess the effects of a therapeutic intervention or to evaluate the natural course of the disease are often performed by different clinicians. When serial NCV studies are conducted by different electromyographers to look for changes in nerve functioning, it is essential to know the amount of repeatability present, in order to interpret these serial studies.

There are many different protocols for median nerve sensory conduction study to help diagnosis of CTS but still there is debate about the most appropriate technique for evaluating median nerve conduction.[8]

Table 1: Interpractitioner difference

Parameter	Patients (*n* = 23)		ICC	*P* value
	Practitioner 1	Practitioner 2		
W-SNAP latency	3.13 (2.55-3.7)	3.11 (2.6-3.65)	0.93	*P*<0.001
P-SNAP latency	1.77 (1.4-2.15)	1.76 (1.4-2.1)	0.88	*P*<0.001
Velocity	52.13 (40-61)	52.37 (42-60.9)	0.87	*P*<0.001

W-SNAP: Sensory nerve action potential latencies with stimulation at wrist, P-SNAP: Sensory nerve action potential latencies with stimulation at palm

Table 2: Intrapractitioner difference

Parameter	Patients (*n* = 23)		ICC	*P* value
	Baseline	One week later		
W-SNAP latency	3.19 (2.9-3.6)	3.11 (2.6-3.65)	0.60	0.01
P-SNAP latency	1.81 (1.5-2.15)	1.76 (1.4-2.1)	0.50	0.05
Velocity	52.11 (41-61)	52.37 (42-60.9)	0.47	0.07

W-SNAP: Sensory nerve action potential latencies with stimulation at wrist, P-SNAP: Sensory nerve action potential latencies with stimulation at palm

In transcarpal technique, it is possible to calculate NCV in the carpal tunnel by subtracting latency of the palm stimulation from that of the wrist. It is of importance because this method can accurately determine the involved segment of the median nerve, particularly in the early stages of the disease.[8,13]

Another advantage of this technique is its ability to compare the median sensory nerve amplitude by stimulation of the wrist and palm, as well as assessing any probability of conduction block.[13]

Although methods for evaluating nerve function have evolved since the 1940s,[14] reliability has rarely been assessed. In our study, we confirmed this validity by repeating the test by a different examiner and one week interval. Previous studies demonstrated a sensitivity of 99%[9] and 100% specificity[15] for this method. The last one also showed that this method had the coefficient of variance of 12% (smaller coefficient of variance suggests smaller variability of the measured value); in another study it was reported that combined sensory index (CSI) had the highest test-retest reliability when compared to other components of CSI individually, because combining multiple tests into one summary score produces a higher reliability as compared to individual tests.[16] The study by Salerno *et al*.,[17] showed excellent interexaminer and intraexaminer reliability in the sensory latency measurement of the median nerve at wrist (ICC range, 0.76 to 0.92). In our study, interpractitioner reliability of the sensory latencies at the wrist and palm and transcarpal velocity of the median nerve were excellent, but like the previous study, results of the current study showed lower intrapractitioner ICCs than interpractitioner ones. One factor that may have influenced intrapractitioner reliability was timing. As mentioned, there was one week interval. During that time, there were no modifications in job tasks, but perhaps some patients had reduced their job tasks due to their symptoms involuntarily. The worse intrapractitioner reliability compared with interpractitioner reliability suggests the possibility that nerve conditions may have been different, reducing apparent intrapractitioner reliability.

One of our shortcomings in this study was not comparing this method to other methods. We acknowledge that these values are influenced by biologic determinants such as the subjects' age, gender, body mass index, or other anthropometric factors.[17] It is suggested that in future studies the results should be compared to a reference group and other methods for assessing validity of this method.

Unfortunately our study enrolled only a small number of patients and the results should be interpreted with caution.

Conclusion

In conclusion, our findings suggest excellent interpractitioner test-retest reliability of median sensory nerve latencies with wrist and palm stimulation and excellent interpractitioner test-retest reliability of transcarpal median sensory NCV method for diagnosing CTS.

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